University of Mumbai

No. AAMS_UGS/ICC/2022-23/ 177

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/130 of 2016-17 dated 9th November, 2016, relating to the revised syllabus as per Choice Based Credit System for Master of Engineering (Mechanical) Manufacturing System Engineering Sem. I to IV.

You are hereby informed that the recommendations made by the Board of Studies in **Mechanical Engineering** at its meeting held on 31st May, 2022 and subsequently passed in the Faculty and then by the Board of Deans at its meeting held on 5th July, 2022 **vide** item No. 6.51 (R) have been accepted by the Academic Council at its meeting held on 11th July, 2022 **vide** item No. 6.51 (R) and that in accordance therewith, the revised syllabus of **M.E. (Manufacturing System Engineering) (Sem.- I to IV) (CBCS) (REV - 2022 Scheme)**, has been brought into force with effect from the academic year 2022-23. (The circular is available on the University's website www.mu.ac.in).

(Prof. Sunil Bhirud)
I/c Registrar

MUMBAI – 400 032
19th November, 2022

To

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.51 (R)/11/07/2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies in Mechanical Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

Copy to :-

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publication Section),**
7. **The Deputy Registrar, (Special Cell),**
8. **The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
9. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

1. **P.A to Hon'ble Vice-Chancellor,**
2. **P.A Pro-Vice-Chancellor,**
3. **P.A to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A to Finance & Account Officers, (F.& A.O),**
6. **P.A to Director, Board of Examinations and Evaluation,**
7. **P.A to Director, Innovation, Incubation and Linkages,**
8. **P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Walfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-Campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA**

for information.

AC – 11 July, 2022

Item No. – 6.51 (R)

University of Mumbai

Revised Syllabus for

M.E.

(Manufacturing System Engineering)

Semester – (Ito IV)

(Choice Based Credit System)

(With effect from the academic year 2022-23)

University of Mumbai

O: _____ Title of Course	**M.E. (Manufacturing Systems Engineering)**
O: _____ Eligibility	Ordinance 0.5134
R: _____ Passing Marks	45%
No. of years/Semesters:	4 semesters
Level:	P.G. / ~~U.G./ Diploma / Certificate~~
Pattern:	~~Yearly~~ / Semester
Status:	~~New~~ / Revised
To be implemented from Academic Year :	With effect from Academic Year : 2022-23

Dr. Vivek Sunnapwar
Chairman
of Board of Studies in Mechanical Engineering

Dr. Suresh K. Ukarande
Associate Dean,
Faculty of Science and Technology

Dr Anuradha Majumdar
Dean,
Faculty of Science and Technology

University of Mumbai, ME (Mechanical) Manufacturing Systems Engineering, Rev 2022

Preamble

Education in engineering is growing in India and is expected to increase by a factor of several in the near future. The current situation presents a significant challenge in terms of ensuring quality to stakeholders while expanding. To face this challenge, the problem of quality must be addressed, debated, and progressed in a methodical manner. Accreditation is the primary form of quality assurance in higher education, and it signifies that the institution or programme of study is committed to meeting certain minimum stated requirements and is available to external assessment in order to get recognition. The main goal of this accrediting procedure is to assess the outcomes of the programme being evaluated. Program outcomes are a collection of skills and information that a student will possess upon completion of the programme. In keeping with this, the University of Mumbai's Faculty of Science and Technology has taken the lead in implementing the principle of outcome-based education into the curriculum building process.

We are pleased to report that the Postgraduate Program Educational Objectives were completed in a brainstorming session attended by more than 20 members from the University's associated institutes. They were either department heads or senior faculty from the Mechanical Engineering Department. The Program Educational Objectives finalized for the postgraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.

2. To prepare the Learner to use modern tools effectively in order to solve real life problems.

3. To prepare the Learner for a successful career in Indian and Multinational Organisations

4. To encourage and motivate the Learner in the art of self-learning.

5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner’s thought process.

In addition to the aforementioned, linked Institutes may add 2 to 3 additional programme instructional objectives of their own. In addition to Program Educational Objectives, each course in a postgraduate program's curriculum includes objectives and expected outcomes from the perspective of the learner to support the idea of outcome-based education. We are convinced that even a tiny move in the correct manner will go a long way toward ensuring that the main stakeholders receive high-quality education.

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

Preface

To tackle the challenge of assuring engineering education excellence, the problem of quality must be addressed, debated, and progressed in a methodical manner. Accreditation is the primary way of ensuring the quality of higher education. The main goal of the certification procedure is to determine how good a company is. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome-based education in the process of curriculum development.

Faculty of Science and Technology, University of Mumbai, in one of its meetings collectively resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEOs), give freedom to Affiliated Institutes to add few (PEOs), course objectives course outcomes to be clearly defined for each course, so that all faculty members in linked institutes are aware of the depth of approach to the subject to be given, so improving the learning process of students It was also decided that while changing the curriculum, the most senior academics from institutions and industry specialists should be included.

We are happy to state that the Board of studies has adhered to the resolutions passed by Faculty of Technology and developed curriculum accordingly. In addition to outcome-based education, Choice Based Credit System is also introduced to ensure quality of engineering education.

Choice Based Credit and Grading System allows for a much-needed shift in education focus from teacher-centric to learner-centric, since the workload estimate is based on time spent learning rather than teaching. It also emphasises constant evaluation, which will improve educational quality. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy, adopting a ten-point scale to grade learner's performance. REV-2022 scheme is implemented for Master of Engineering from the academic year 2022-2023.

We trust this revised version of syllabus come up to the expectations of all stakeholders. We wish to place on record our sincere thanks and appreciations to the various contributors from the academia and industry for their most learned inputs in framing this syllabus.

Board of Studies in Mechanical Engineering

Dr. Vivek K. Sunnapwar : Chairman
Dr. S. M. Khot : Member
Dr. V. M. Phalle : Member
Dr. Siddappa Bhusnoor : Member
Dr. S.S. Pawar : Member
Dr. Sanjay U. Bokade : Member
Dr. Dhanraj Tambuskar : Member
Dr. V. B. Tungikar : Member
Dr. K.P. Karunakaran : Member
Dr. S. S. Thipse : Member
Dr. Milind Deshmukh : Member

Semester I

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
MSEC101	Computer Integrated Manufacturing Systems	3	--	--	3	--	--	3
MSEC102	Quality Engineering	3		--	3		--	3
MSEPE101X	Program Elective 1	3	--	--	3	--	--	3
MSEPE102X	Program Elective 2	3	--	--	3	--	--	3
MSEIE101X	Institute Elective 1	3	--	--	3	--	--	3
MSEL101	Computer Integrated Manufacturing Lab	--	2	--	--	1	--	1
MSESBL101	Advanced Manufacturing Lab	--	4[$]	--	--	2	--	2
Total		**15**	**06**	**--**	**15**	**03**	**--**	**18**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test-1	Test-2	Avg					
MSEC101	Computer Integrated Manufacturing Systems	20	20	20	80	3	--	--	100
MSEC102	Quality Engineering	20	20	20	80	3	--	--	100
MSEPE101X	Program Elective 1	20	20	20	80	3	--	--	100
MSEPE102X	Program Elective 2	20	20	20	80	3	--	--	100
MSEIE101X	Institute Elective 1	20	20	20	80	3	--	--	100
MSEL101	Computer Integrated Manufacturing Lab	--	--	--	--	--	25	25	50
MSESBL101	Advanced Manufacturing Lab	--	--	--	--	--	50	50	100
Total		**--**	**--**	**100**	**400**	**--**	**75**	**75**	**650**

Course Code	Program Elective 1	Course Code	Program Elective 2	Course Code	Institute Elective 1
MSEPE1011	New Product Design & Development	MSEPE1021	Precision Engineering	MSEIE1011	Product Lifecycle Management
MSEPE1012	Advanced Materials Science	MSEPE1022	Knowledge Management	MSEIE1012	Reliability Engineering
MSEPE1013	World Class Manufacturing	MSEPE1023	Micro and Nano Manufacturing	MSEIE1013	Management Information System
				MSEIE1014	Design of Experiments
				MSEIE1015	Operation Research
				MSEIE1016	Cyber Security and Laws
				MSEIE1017	Disaster Management and Mitigation Measures
				MSEIE1018	Energy Audit and Management

Course Code	Course Name	Credits
MSEC101	**Computer Integrated Manufacturing Systems**	**03**

Objectives:

1. To understand overall aspects of manufacturing systems and the manufacturing supporting systems.
2. To understand the CIM database and database management system of a manufacturing firm.
3. To understand the functioning of computer integrated manufacturing Enterprise.

Outcomes: On completion of the course, learner will be able to:

1. Understand the basic principles of CIM and its elements.
2. Distinguish different types of inspection methods.
3. Emphasis the importance of group technology and cellular manufacturing systems.
4. Design automated material handling and storage systems for a typical production system.
5. Understand the importance of data communications in CIM environment.

Module	Detailed Contents	Hrs.
01	**Introduction to CIM:** Introduction to CIM, Evolution, objectives, benefits, limitations, relationship between automation and CIM, CIM hardware and software, role and functioning of elements of CIM, CIM Wheel.	**07**
02	**Computer Process Monitoring and Control:** Computer Process Monitoring: Data logging Systems-Data acquisition systems- Multilevel scanning. Computer Control: Computer-Process Interfacing-Manufacturing Process Data- System Interpretation of Process Data-Interface Hardware Devices-Digital Input /Output Processing Interrupt system-Control programming-Computer Process Control-Structural Model of a Manufacturing Process- Process Control Strategies-Distributed Control versus Central Control- Supervisory Computer Control.	**08**
03	**Development and implementation of an FMS:** Planning phase, Integration, System configuration, FMS layouts, Simulation, FMS Project development steps. Project management, Equipment development, Host system development, planning, Hardware & Software development. **Automated Material Handling & Storage:** Functions, Types, Analysis of material handling equipment's, Design of Conveyor & AGV systems. Problems. Development for total material handling system (Case study: Automatic Identification and data capturing).	**06**
04	**Computer Aided Process Planning and Quality Control:** **(CAPP):** Introduction and types. **(CAQC):** Introduction to inspection and testing. Automated inspection principles and methods- When and where to inspect, quantitative analysis of inspection, inspection technologies – contact and non-contact types. Computer aided testing.	**07**
05	**Cellular Manufacturing Systems:** Part Families, Parts Classification and Coding, Features of Parts Classification and Coding Systems, Opitz of Parts Classification and Coding Systems, Production Flow Analysis, Composite Part Concept, Machine Cell Design, Applications of Group Technology, Quantitative analysis of Cellular Manufacturing, Grouping of parts and Machines by Rank Order Clustering, Arranging Machines in a GT Cell, introduction to just in time and Holonic manufacturing. Concurrent Engineering: Benefits and techniques of Concurrent Engineering, Framework for integration of Life-cycle phases in CE, and Collaborative Product Development.	**07**
06	**Role of Information Systems & Enterprise Wide Integration in CIM and CIM Models:** Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks, Selection of Network Technology, networks for manufacturing, Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration, CIM Models. CIM database and database management systems. Manufacturing Data: Types, sources, Database models, Architecture, Database Management System (DBMS), Product Data Management (PDM), Advantages of PDM.	**07**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Groover, M.P: "Automation, Production System and CIM"- Prentice - Hall of India.
2. Vajpayee, "Principles of CIM" - Prentice-Hall of India.
3. Ranky, Paul G: "Computer Integrated Manufacturing"- Prentice-Hall of India.
4. Nanua Singh, "Systems Approach to Computer Integrated Design and manufacturing" - John Wiley.
5. Geoffrey Boothroyd , "Assembly Automation and Product Design", (Manufacturing Engineering and Materials Processing).
6. Radhakrishnan.P, Subramanyan. S, "CAD/CAM/CIM", New Age International Publishers.

Course Code	Course Name	Credits
MSEC102	**Quality Engineering**	**03**

Objectives:
1. To study fundamentals of statistical techniques.
2. To acquaint with various quality management tools.
3. To overcome obstacles for achieving a successful quality management.
4. To enable and understand Total Quality Management (TQM).

Outcomes: On completion of the course, learner will be able to:
1. Demonstrate the understanding of modern quality concepts.
2. Demonstrate the understanding of statistical quality control charts.
3. Apply standard sampling plans.
4. Analyse modern management trends in quality improvement.
5. Apply concepts of TQM.

Module	Detailed Contents	Hrs.
01	**Quality Dimensions of Products and Services:** Definition & Evolution of Quality, Quality Assurance, and Quality Characteristics (dimensions). Quality Control, Quality tasks & means to control them, Quality costs concept & its categories, Cost reduction program and economics of quality.	**07**
02	**Statistical Quality Control:** Basic Concept of Statistical Quality Control (SQC), Statistical Tools in Quality Control. Concept & causes of variation, statistical aspect of control charting. Concept of rational sub-grouping and detecting patterns on the control charts, for variables and attributes: X and R, p, np, c and u charts; specification and tolerances, natural tolerance limits, specification limits, process capability ratio analysis and studies. Concept of Acceptance Sampling, Lot by lot sampling process, types.	**07**
03	**Total Quality Management:** Basic concepts of TQM, historical review, leadership, concepts, role of senior management, quality statements, plans for process parameters, Implementation of TQM, ISO 9000 quality system, JuransTriology, Deming's Approach to TQM, Zero defect Concept.	**07**
04	**Total Productive Maintenance:** History and Impact of TPM, Overall Equipment Effectiveness (OEE). Developing the TPM implementation Plan, Preventive Maintenance, techniques- FMEA, POKAYOKE and Future of TPM.	**07**
05	**Six Sigma and Modern Quality Management Tools:** Evolution of six-sigma quality approach, steps involved in the application of six sigma, six sigma and Indian Industries. Concept of process capability, Basic & Modern tools in quality improvement, Benchmarking, KAIZEN, JIT, 5-S, Taguchi quality loss function. Introduction to DOE and RSM.	**07**
06	**Case Studies:** Few case studies to understand how companies in various industries successfully implemented QE into their systems and optimized it.	**07**

Assessment:
Internal:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Statistical Quality Control by M. Mahajan.
2. Grant, Eugene. L., "Statistical Quality Control", McGraw-Hill, 1996.
3. Ross, P. Taguchi, "Techniques for Quality Engineering", 2nd edition, McGrawHill,1966.
4. Douglas. C. Montgomery, "Introduction to Statistical quality control", John Wiley, 4th Edition 2001.
5. John.S. Oakland, "Statistical process control", Elsevier, 5th edition, 2005.
6. Besterfield D. H., "Quality Control", Prentice Hall, 1993.
7. Sharma S. C., "Inspection Quality Control and Reliability", Khanna Publishers, 1998.
8. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991.
9. J. Juran, "Quality Control Handbook", Mcgraw Hill USA.
10. A. V. Feigenbaum, "Total quality control", Mcgraw hill Int.edition USA.
11. W. E .Deming, "Out of crisis", Productivity & Quality publishing Pvt. Ltd., Chennai.
12. A. J. Dunkan, "Quality control & Industrial statistics", Richard D. Irwin INC USA.
13. A. Zaidi, "SPC,concepts,Methodology& tools", Prentice Hall India ltd., New Delhi.
14. Terry Wireman, "Total Productive Maintenance", Industrial Press, 2nd Edition, New York.

Course Code	Course Name	Credits
MSEPE1011	**New Product Design & Development**	**03**

Objectives:

1. Acquire a deep understanding & assimilate key concepts pertaining to new product design & development process.
2. Get familiarised with product design & development approach & methodologies based on modern engineering practises, tools and processes.
3. To stimulate creative & inventive solutions to problems.
4. Enable the learner to cope up with the product design challenges posed by the ongoing global competitive scenario.

Outcomes: On completion of the course, learner will be able to:

1. Understand the generic product design & development process, tools and methodologies.
2. Get familiarised with product life cycle & product life cycle assessment.
3. Get familiarised with various software solutions and choose appropriate design approaches.
4. Understand product costing approach and economic feasibility of the product.
5. Get conversant with I.P rights & patenting procedure.

Module	Detailed Contents	Hrs.
01	**Introduction:** Definition of product design, classification of products and product mix, product architecture. Various considerations for design. Generic steps involved in modern design and development process. Generation of concepts and embodiment of concept. Morphology of design, Design optimization.	**07**
02	**Development Process:** Product life cycle & its implications, identifying customer needs, Kano Model, Bench marking techniques & establishing engineering specifications, creativity techniques, simulation, Rapid Prototyping techniques, Axiomatic design, Pugh concept selection approach, Weighted design matrix.	**07**
03	**Design Process:** Design for manufacturing & assembly (DFMA) , Design for Reliability & Maintainability, Green Design, Sustainable design, Nano design, Sequential and Concurrent design, Reverse engineering techniques, Robust Design & Taguchi's DOE, Legal , Social & Ethical issues related to Design.	**07**
04	**Ergonomics & Aesthetics:** Concepts of human engineering, Psychological & Physiological Considerations, Anthropometry, Workplace, Man- Machine interaction, Comfort Criteria, Environmental Conditions including temperature, illusion, noise, vibrations, control panels and displays. Visual communication skills related to products & services, Concepts of size, shape & texture, Generation of product forms, analogies from nature, colours and colour wheel, psychological implications & interaction of colours.	**07**
05	**Product Costing:** Product costing elements and methodology of product costing. Economic analysis – qualitative and quantitative, Techno commercial viability, case studies on product costing. Value engineering/value analysis – methodology, value engineering job plan, value engineering check list, case studies on value engineering.	**07**
06	**Software solutions& IP Rights:** Drafting Modeling, CAD/CAE tools, CAM interface, CAPP, various softwares employed and their capabilities. Patents & IP Acts – overview & disclosure preparation.	**07**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Karl T. Ulrich, Steven D. Eppinger, "Product Design & Development", Tata McGrawhill New Delhi, 2003.
2. David G. Ullman, "The Mechanical Design Process", McGrawhill Inc. Singapore, 1992.
3. N. J. M. Roozenberg, J. Ekels, N. F. M. Roozenberg, "Product Design Fundamentals and Methods", John Willey & Sons, 1995.
4. Byers, Mel, "The Design Encyclopedia", John Wiley & Sons, 1994.
5. Kevin Otto & Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", 1/e 2004, Pearson Education, New Delhi.
6. L. D. Miles, "Value Engineering".
7. Hollins B. & Pugh S., "Successful Product Design", Butterworths London.
8. Baldwin E. N. &Neibel B. W., "Designing for Production", Edwin Homewood Illinois.
9. Jones J. C., "Design Methods", John Willey New York.
10. Bralla J. G., "Handbook of Product Design for Manufacture", McGrawhill New York.

Course Code	Course Name	Credits
MSEPE1012	**Advanced Materials Science**	**03**

Objectives:

1. To give fundamental knowledge about type of materials, their usage, properties and characteristics, which are important in engineering design.
2. To give a theoretical background about the analysis of behaviour of engineering materials by emphasizing important relationships between internal structure and properties.
3. To understand the relationship between Nano/microstructure, characterization, properties and processing and design of materials.
4. To Understand the behaviour of composite material.
5. To Differentiate the properties and applications of metals, ceramics, polymers and composite materials. Understand the significance, properties and applications of nanomaterials.

Outcomes: On completion of the course, learner will be able to:

1. Demonstrate extensive knowledge and skills related to selected topics covered by the course.
2. Use this knowledge and skills to discuss and analyse relevant problems connected to these topics.

Module	Detailed Contents	Hrs.
01	**Review of fundamentals:** Covalent, Ionic, Metallic and Van-der Walls Bond, Bond strength and melting point, Crystalline structures, Vacancies, Dislocations and other crystal defects. Metals Vs Alloys – Microstructure characterization.	**06**
02	**Mechanical behaviour of metals and alloys:** Elastic and plastic behaviour, Tensile & compressive stress-strain relations for elastic behaviours. Fracture toughness, fatigue failure, creep failure, wear and abrasion.	**05**
03	**Metals and alloys:** HSLA Steels, tool and die materials, alloy cast-irons, stainless steels, PH and Maraging steels. Materials for low temperature applications, refractory metals and super alloys, hard field steels, ball bearing steels, automobile alloys and aerospace alloys.	**05**
04	**Polymers:** Definitions, Classifications, Monomers, Polymerization principles, Addition, Condensation, Mass ,Suspensions and emulsion polymerizations Classification – Thermoplastic and Thermosets, Crystalline and Amorphous, Natural and Synthetic, Linear, branched and cross-linked; Engineering, commodity and speciality polymers Homo polymers and co-polymers, Elastomers and Thermoplastic elastomers Polymer Blends and Alloys, Liquid crystal polymers, Polymer foams Properties and applications of polymers, Viscoelastic, Thermal, Electrical, Optical, Environmental & Mechanical behaviour. Important thermoplastics and thermosets - their moulding characteristics, properties and applications.	**12**
05	**Ceramics and Composite:** Various ceramic materials and their applications Engineering ceramics, Environmental influence on ceramics Ceramic crystal structures – Binary and Ternary structures. **Fundamentals of composite:** Definition, Classification of composite materials, Laws of mixtures, Factors affecting composite properties, Interfacial bonding, Mechanical Behaviour of Composites, Glass fibers, Carbon fibers, Silicon Carbide fibers, and Metallic Glasses.	**06**
06	**Advanced Materials:** Concept of Nano materials, scale and dimensional aspects for preparing Nano materials synthesis and properties, applications of Nano materials. Biomaterials, super alloys, shape memory alloys. Carbon as a special material, Smart materials. Nano -Physics, Preparation of Nano phase materials -Sol -gel, electro- deposition, plasma assisted deposition, Molecular beam epitaxy etc. Advanced Nano - composites Thin film preparation of metal oxides, Application of Nanostructured Materials.	**08**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Materials Science by R. S. Khurmi& R. S. Sedha, S. Chand & Co.
2. Mechanical Metallurgy by George Dieter, Mc Grawhill.
3. Heat Treatment Principles by Rajan, Sharma & Sharma Prentice Hall.
4. Plastics Engg by R. J. Crawford, Butterworth Hieneman.
5. Composite Materials Scence& Engineering by Krishnan Chawla, Springer Verlag.
6. Plastics Technology Handbook by M. Chandra & S. K. Roy, Marcel Dekker.
7. Mechanical properties of ceramics by John B. Wactman, John Willey & Sons.
8. Metal Matrix composites: Thermomechanical behaviour by Taya M. & Arsenault R. J., Pergamon press - Oxford.
9. Analysis & performance of fibre composites by B D Agarwal & L J Broutman, John Willey & sons - New York.
10. Transport in Nanostructures, D. K. Ferry and S. M. Goodnick, Cambridge University Press, 1997.
11. Chemistry of Advanced Materials, Edited L. V. Interrante and M. J. Hampden-Smith, Wiley–VCH - U.S.A., 1998.

Course Code	Course Name	Credits
MSEPE1013	**World Class Manufacturing**	**03**

Objectives:

1. Help the learner understand and assimilate deeper insights into the opportunities & challenges faced by manufacturing as a domain today.
2. Prepare the learner to face the demands and complexities of a global market place.

Outcomes: On completion of the course, learner will be able to:

1. Understand the relevance and basics of World Class Manufacturing.
2. Design and develop a roadmap for world class manufacturing.
3. Meet the challenges that the Indian manufacturer's faces, as it evolves from a domestic to a world class global manufacturer status.

Module	Detailed Contents	Hrs.
01	**Historical Perspective:** World class manufacturing organizations, Models for manufacturing excellence: Schonberger, Halls, Gunn and Maskell models, Business Excellence. Globalization and International Business; Global Competitiveness and Manufacturing Excellence, Manufacturing and Information age competition; Manufacturing challenges and Problems in Manufacturing Industries.	06
02	**System and Tools for World Class Manufacturing:** Improving Product & Process Design – Lean Production – SQC, FMS, Rapid Prototyping, Poka Yoke, 5-S, 3 M, JIT, Product Mix, Optimization, Procurement & stores practices. Total Productive maintenance, Visual Control.	07
03	**Benchmark, Bottlenecks and Best Practices:** Concepts of benchmarking, Bottleneck and best practices, Best performers Gaining competitive edge through world class manufacturing Value added manufacturing, Value Stream mapping, Eliminating waste, Toyota Production System, Example.	07
04	**HR Dimensions in WCM – WCM Strategy Formulation:** Adding value to the organization, Organizational learning – techniques of removing Root cause of problems – People as problem solvers, New organizational structures. Associates, Facilitators – Teamsmanship, Motivation and reward in the age of continuous improvement.	07
05	**Typical Characteristics of WCM Companies:** Performance indicators like POP, TOPP and AMBITE systems– what is world class Performance –Six Sigma philosophy.	07
06	**Competitive Indian Manufacturing:** Manufacturing Performance and competitiveness of Indian Firms, Manufacturing objectives and Strategy, Usage of Management Tools and Technologies. Manufacturing Management Practices, IT Infrastructure and Practices, Strategic Intent Framework, Breadth and Integration of IT Infrastructure, The Future WCM. Manufacturing strategy: Futile search for an Elusive Link, Manufacturing Strategic Intent classification translating into action. **WCM - the Indian Scenario:** Case studies on leading Indian companies moving towards world class manufacturing – Task Ahead. Green Manufacturing, Clean manufacturing, Agile manufacturing.	08

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Sahay B. S., Saxena KBC and Ashish Kumar, "World Class Manufacturing - Strategic Perspective Mac Milan Publications", New Delhi.
2. Korgaonkar M. G., "Just In Time Manufacturing", MacMilan Publications.
3. Narayanan V. K., "Managing Technology and Innovation for Competitive Advantage", Prentice Hall, 2000.
4. Adam and Ebert, "Production and Operational Management", 5th Edition, Prentice Hall learning Pvt. Ltd., New Delhi.
5. Ron Moore, "Making Common Sense Common Practice – Models for manufacturing Excellence", Butter worth Heinmann.
6. Jeffrey K. Liker "The Toyota Way – 14 Management Principles", Mc-Graw Hill, 2003.
7. Chase Richard B., Jacob Robert., Operations Management for Competitive Advantage", 11th Edition, McGraw Hill Publications, 2005.

Course Code	Course Name	Credits
MSEPE1021	**Precision Engineering**	**03**

Objectives:

1. To understand the need for precision and application.
2. To understand concepts of accuracy and errors due to numerical interpolation.
3. To understand the aspects of precision engineering like precision Materials, Measurement and Machining.

Outcomes: On completion of the course, learner will be able to:

1. Enhance his/her knowledge in Precision Engineering and its applications.
2. Explore new dimension of research in the field of precision and ultra-precision materials and Machining methods.

Module	Detailed Contents	Hrs.
01	**Accuracy and precision:** Introduction - concept of accuracy and precision, Need for high precision, Accuracy of numerical control systems. Errors due to numerical interpolation - displacement measurement system and velocity lags.	**06**
02	**Geometric Dimensioning and Tolerancing:** Interpretation, measurement and application of form tolerances, datum system. Targets –tolerance of position Tolerance zone conversions , Surfaces, features, features of size, datum features-Datum, oddly configured and curved surfaces as datum features, equalizing datum.	**06**
03	**Precision Materials and Machining:** Diamond – types-single crystal- PCD, Natural-synthetic CBN, Ceramics – coated metals and nonmetals, High performance polymer, alloys, refractory metals: cutting tools performance, Components of instruments, Jewels self-Lubrication, smart materials – properties, testing, applications. Precision Machining :Precision grinding- High-speed grinding, High-speed Milling-Micromachining, Diamond turning-MEMS, micro finishing process.	**05**
04	**Precision Measuring Systems:** Units of length, legal basis for length measurement, Traceability – Processing system of nanometer accuracies, LASER light source - LASER interferometer, LASER alignment telescope, LASER micrometer-on-line and in-process measurements of diameter and surface roughness using LASER - Micro holes and topography measurements- In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems. Straightness. Flatness measurement – Optoelectronic Measurement Systems in Metrology, Opto electronic devices contact and non-contact types Applications - Tool wear measurement, 3D Surface roughness, and Pattern generation studies.	**09**
05	**Nano-Positioning Systems of Nano Accuracy & Repeatability:** Guide systems for moving elements - Servo control systems for tool positioning Computer Aided digital and ultra-precision position control.	**09**
06	**Computer Integrated Quality Assurance:** Concept of Total quality control & quality assurance, Zero defects-POKAYOKE Statistical evaluation of data using computer, CNC CMM applications - Computer Aided measurement, data integration of 3D-CMM.	**07**

Assessment:

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End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Murthy R. L., “Precision Engineering in Manufacturing”, New Age International (P) Limited, 1996.
2. James D. Meadows, - “Geometric Dimensioning and Tolerancing”, Marcel Dekker Inc.,1995.
3. Spotts, “Dimensioning and tolerancing of mass production”, Prentice Hall, 1983.
4. Watson. J., " Optoelectronics”, Van Nostrand Rein hold (UK) Co. ltd.,1988.
5. Robert. G. Seippel, - “Optoelectronics for Technology and Engineering”, Prentice Hall NewJersey,1989.
6. Ulrich-Rembold, Armbruster and Ulzmann, “Interface technology for computer controlled manufacturing processes", Marcel Dekker Pub. - New York, 1993.
7. John Frederick Wise Galyer, Charles Reginald Shotbolt, "Metrology for Engineers", Cassell
8. Thomas. G. G., “Engineering metrology”, Butterworth Pub.,1974.
9. Norio Taniguchi, “Nano Technology”, Oxford university Press, 1996.
10. Venkatesh V. C. and Sudin I., “Precision engineering”, Tata McGraw Hill Co.-New Delhi.
11. David Dorifield, Dae Eur Lee, “Precision Manufacturing”, Springer Publishers, 2008.
12. Anthony James Thomas Scarr, “Metrology and Precision Engineering”, McGraw-Hill.

Course Code	Course Name	Credits
MSEPE1022	**Knowledge Management**	**03**

Objectives:

1. Define KM, learning organizations, intellectual capital and understand the role of knowledge management in organizations and its successful system life cycle.
2. Identify and use tools and techniques of KM for the different stages of creation, acquisition, transfer and management of knowledge.
3. Analyze and evaluate tangible and intangible knowledge assets and address current KM issues.
4. Evaluate the impact of new technologies such as networks and Internet/intranet role in managing knowledge.
5. By understanding of the importance of intellectual capital, articulate how to create the competitive advantage in manufacturing and other organizations.

Outcomes: On completion of the course, learner will be able to:

1. Understand the importance of intellectual capital to benefit in the competitive advantage and how to create conducive KM infrastructure in organizations.
2. Choose application packages in KM and the issues in designing and developing knowledge databases (including intranets and groupware).
3. Develop a working knowledge in the area through focused projects and career options.
4. Analyze impacts of implementation of KM infrastructure.

Module	Detailed Contents	Hrs.
01	**Introduction to Knowledge Management:** Data, Information and Knowledge, KM Myths, KM Life Cycle, Understanding Knowledge, Knowledge, intelligence, Experience, Cognition. KM Types of Knowledge, Expert Knowledge, Human Thinking and Learning, Learning Organization-Characteristics, benefits, challenges of Learning Organization.	**06**
02	**Knowledge Management System Life Cycle:** Challenges in Building KM Systems – key differences of Conventional and KM System Life Cycle, Knowledge Creation. Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture and its layers.	**08**
03	**Knowledge Capturing:** Evaluating the Expert – Developing a Relationship with Experts – Fuzzy Reasoning. The Quality of Knowledge – Knowledge Capturing or discovery Techniques, Brain Storming, storytelling, knowledge sharing,– Protocol Analysis – knowledge application systems (expert systems and decision support systems- Consensus Decision Making – Repertory Grid for competency mapping- Concept Mapping and use of software's.	**08**
04	**Knowledge Codification and Coordination:** Principles of K Codification -Modes of Knowledge Conversion, Codification Tools and Procedures, Knowledge Developer's Skill Sets, System Testing. Deployment, Knowledge Testing, Approaches to Logical Testing, User Acceptance Testing, KM System Deployment Issues, User Training, Post implementation.	**08**
05	**Knowledge Transfer and Sharing:** Transfer Methods, Role of the Internet, Knowledge Transfer in e-world, KM System, Tools, Neural Network, Association Rules, Classification Trees, and Data Mining. Business Intelligence, Decision Making Architecture, Data Management, Knowledge Management Protocols, Managing Knowledge Workers.	**06**
06	**Knowledge Management in Manufacturing:** How to foster innovation within own organizations - policy adoption of new 08 University of Mumbai, ME (Mechanical) Manufacturing Systems Engineering, Rev 2016 20 management methods, to actual innovation or to ICT use, organizational responsiveness, innovation, competency and efficiency (RICE), knowledge sharing, utilization and its evaluation, Knowledge value chain, illustrative case studies in manufacturing.	**06**

Assessment:

Internal:

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End Semester Theory Examination:

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2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Elias. M. Award & Hassan M. Ghaziri, "Knowledge Management", Pearson Education 2003.
2. Guus Schreiber, Hans Akkermans, AnjoAnjewierden, Robert de Hoog, Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering and Management", Universities Press, 2001.
3. C. W. Holsapple, "Handbooks on Knowledge Management", International Handbooks on Information Systems, Vol 1 and 2, 2003.
4. Davenport, Thomas H. &Prusak, Laurence, "Working Knowledge: How Organizations Manage What They Know", Harvard Business School Press.
5. Nonake, Ikujiro& Takeuchi, Hirotaka, "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", 2010.

Course Code	Course Name	Credits
MSEPE1023	**Micro and Nano Manufacturing**	**03**

Objectives:

1. To give awareness of different techniques used in micro and nano manufacturing.
2. To give in-depth idea of the conventional techniques used in micro manufacturing.
3. To introduce Non-conventional micro-nano manufacturing and finishing approaches.
4. To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano manufacturing.
5. To know different techniques used in Micro Joining and the metrology tools in micro and nano manufacturing.

Outcomes: On completion of the course, learner will be able to:

1. Get an awareness of different techniques used in micro and nano manufacturing.
2. Get in-depth idea of the conventional techniques used in micro manufacturing.
3. Become aware about non-conventional micro-nano manufacturing and finishing approaches.
4. Get awareness on micro and nano finishing processes.
5. Understand micro and nanofabrication techniques and other processing routes in micro and nano manufacturing.
6. Know about different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

Module	Detailed Contents	Hrs.
01	**Introduction to Precision engineering:** Macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications. Introduction to Precision engineering, macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications, Introduction to Bulk micromachining, Surface micromachining- steps, Micro instrumentation – applications, Micro Mechatronics, Nanofinishing – finishing operations. Laser technology in micro manufacturing- Practical Lasers, application of technology fundamentals. Introduction to Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Introduction to Nanotechnology, Carbon Nano-tubes – properties and structures, Molecular Logic Gates and Nano level Biosensors – applications.	**06**
02	**Introduction to mechanical micromachining:** Micro drilling – process, tools and applications. Micro turning- process, tools and applications, Diamond Micro turning – process, tools and applications. Micro milling and Micro grinding – process, tools and applications. Micro extrusion- process and applications. micro bending with Laser. Nano-Plastic forming and Roller Imprinting.	**06**
03	**Introduction to Non-conventional micro-nano manufacturing:** Process, principle and applications – Abrasive Jet Micro Machining, WAJMM. Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications. Micro ECM, Micro LBM - Process principle, description and applications. Focused ion beams - Principle and applications.	**07**
04	**Introduction to Micro and Nano Finishing Processes:** Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes (MRAFF) – process principle and applications. Force analysis of MRAFF process, Magnetorheological Jet finishing processes. Working principle and polishing performance of MR Jet Machine.Elastic Emission Machining (EEM) – machine description, applications. Ion Beam Machining (IBM) – principle, mechanism of material removal, applications. Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications.	**08**
05	**Introduction to Micro Fabrication:** Basics, flowchart, basic chip making processes. **Introduction to Nanofabrication:** Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp) Manipulative techniques – process principle, applications. Introduction to Carbon nano materials – CN Tubes CN Tubes – properties and applications CN Tube Transistors – Description only Diamond - Properties and applications, CVD Diamond Technology LIGA Process.	**08**
06	**Laser Micro welding:** Laser Micro welding – description and applications, Defects Electron Beam Micro-welding – description and applications Introduction to micro and nano measurement, defining the scale, Uncertainty Scanning Electron Microscopy – description, principle Scanning White-light Interferometry – Principle and application Optical Microscopy – description, application Scanning Probe Microscopy, scanning tunneling microscopy description, application Confocal Microscopy - description, application Introduction to On-Machine Metrology.	**07**

Assessment:
Internal:
Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:
Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

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4. Only Four questions need to be solved.

References:

1. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
2. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.
3. NitaigourPremchandMahalik, Micro-manufacturing and Nanotechnology, 2006.
4. V. K. Jain, Micro-manufacturing Processes, CRC Press, 2012.

Course Code	Course Name	Credits
MSEIE1011	**Product Life Cycle Management**	**03**

Objectives:

1. To familiarize the students with the need, benefits and components of PLM.
2. To acquaint students with Product Data Management & PLM strategies.
3. To give insights into new product development program and guidelines for designing and developing a product.
4. To familiarize the students with Virtual Product Development.

Outcomes: On completion of the course, learner will be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant.

Module	Detailed Contents	Hrs.
01	**Introduction to Product Lifecycle Management (PLM):** Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications. **PLM Strategies:** Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM.	**07**
02	**Product Design:** Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and their use in the Design Process.	**07**
03	**Product Data Management (PDM):** Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation.	**07**
04	**Virtual Product Development Tools:** For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies.	**07**
05	**Integration of Environmental Aspects in Product Design:** Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design.	**07**
06	**Life Cycle Assessment and Life Cycle Cost Analysis:** Properties, and Framework of LCA, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis.	**07**

Assessment:

Internal:

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End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer-Verlag, 2004. ISBN: 1852338105.
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229.
3. SaaksvuoriAntti, ImmonenAnselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314.
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265.

Course Code	Course Name	Credits
MSEIE1012	**Reliability Engineering**	**03**

Objectives:

1. To familiarize the students with various aspects of probability theory.
2. To acquaint the students with reliability and its concepts.
3. To introduce the students to methods of estimating the system reliability of simple and complex systems.
4. To understand the various aspects of Maintainability, Availability and FMEA procedure.

Outcomes: On completion of the course, learner will be able to:

1. Apply the concept of Probability to engineering problems.
2. Apply various reliability concepts to calculate different reliability parameters.
3. Estimate the system reliability of simple and complex systems.
4. Carry out a Failure Mode Effect and Criticality Analysis.

Module	Detailed Contents	Hrs.
01	**Probability theory:** Standard definitions and concepts; Conditional Probability, Baye's Theorem. **Probability Distributions:** Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. **Measures of Dispersion:** Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	**06**
02	**Reliability Concepts:** Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. **Failure Data Analysis:** Hazard rate, failure density, Failure Rate, Mean Time to Failure (MTTF), MTBF, Reliability Functions. **Reliability Hazard Models:** Constant Failure Rate, linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	**08**
03	**System Reliability:** System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	**06**
04	**Reliability Improvement:** Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	**08**
05	**Maintainability and Availability:** System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	**08**
06	**Failure Mode, Effects and Criticality Analysis:** Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis.	**06**

Assessment:

Internal:

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4. Only Four questions need to be solved.

References:

1. L.S. Srinath, “Reliability Engineering”, Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Conor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
MSEIE1013	**Management Information System**	**03**

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built.
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage.
4. Identify the basic steps in systems development.

Outcomes: On completion of the course, learner will be able to:

1. Explain how information systems Transform Business.
2. Identify the impact information systems have on an organization.
3. Describe IT infrastructure and its components and its current trend.
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making.
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses.

Module	Detailed Contents	Hrs.
01	**Introduction to Information Systems (IS):** Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	**06**
02	**Data and Knowledge Management:** Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	**08**
03	**Ethical issues and Privacy:** Information Security. Threat to IS, and Security Controls	**06**
04	**Social Computing (SC):** Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	**08**
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	**08**
06	**Information System within Organization:** Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	**06**

Assessment:

Internal:

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4. Only Four questions need to be solved.

References:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley.
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008.

Course Code	Course Name	Credits
MSEIE1014	**Design of Experiments**	**03**

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE).
2. To list the guidelines for designing experiments.
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization.

Outcomes: On completion of the course, learner will be able to:

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action.
2. Apply the methods taught to real life situations.
3. Plan, analyze, and interpret the results of experiments.

Module	Detailed Contents	Hrs.
01	**Introduction:** Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology.	**06**
02	**Fitting Regression Models:** Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit.	**08**
03	**Two-Level Factorial Designs and Analysis:** The 2^2 Design, The 2^3 Design, General 2^k Design, a Single Replicate of the 2^k Design, Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split-Plot Designs.	**08**
04	**Two-Level Fractional Factorial Designs and Analysis:** One-Half Fraction of the 2^k Design, One-Quarter Fraction of the 2^k Design, General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs.	**08**
05	**Conducting Tests:** Testing Logistics, Statistical aspects of conducting tests, Characteristics of good and bad data sets, Example experiments, Attribute vs Variable data sets.	**06**
06	**Taguchi Approach:** Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples	**06**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

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4. Only Four questions need to be solved.

References:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001.
2. D. C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001.
3. George E. P. Box, J. Stuart Hunter, William G. Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley.
4. W. J. Dimond, Practical Experiment Designs for Engineers and Scientists, John Wiley and Sons Inc., ISBN: 0-471-39054-2.
5. A. M. Dean, and D. T. Voss, Design and Analysis of Experiments (Springer text in Statistics), Springer.

Course Code	Course Name	Credits
MSEIE1015	**Operations Research**	**03**

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: On completion of the course, learner will be able to:

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures.

Module	Detailed Contents	Hrs.
01	**Introduction to Operations Research:** Introduction, Structure of the Mathematical Model, Limitations of Operations Research **Linear Programming:** Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method. **Duality:** Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis **Transportation Problem:** Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. **Assignment Problem:** Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem Integer Programming Problem: Introduction, Types of **Integer Programming Problems:**Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	**08**
02	**Queuing models:** Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population.	**06**
03	**Simulation:** Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation.	**06**
04	**Dynamic programming:** Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	**07**
05	**Game Theory:** Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	**08**
06	**Inventory Models:** Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model.	**07**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
MSEIE1016	**Cyber Security and Laws**	**03**

Objectives:

1. To understand and identify different types cybercrime and cyber law.
2. To recognized Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.

Outcomes: On completion of the course, learner will be able to:

1. Understand the concept of cybercrime and its effect on outside world.
2. Interpret and apply IT law in various legal issues.
3. Distinguish different aspects of cyber law.
4. Apply Information Security Standards compliance during software design and development.

Module	Detailed Contents	Hrs.
01	**Introduction to Cybercrime:** Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	**06**
02	**Cyber offenses & Cybercrime:** How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	**08**
03	**Tools and Methods Used in Cyberline:** Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft).	**06**
04	**The Concept of Cyberspace:** E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law.	**08**
05	**Indian IT Act.:** Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments.	**08**
06	**Information Security Standard compliances:** SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	**06**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Nina Godbole, SunitBelapure, "Cyber Security", Wiley India, New Delhi.
2. Suresh T. Vishwanathan, "The Indian Cyber Law", Bharat Law House New Delhi.
3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Advocate Prashant Mali, "Cyber Law & Cyber Crimes", Snow White Publications, Mumbai.
5. Nina Godbole, Information Systems Security", Wiley India, New Delhi.
6. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication.
8. Websites for more information is available on: The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in.
9. Website for more information - A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538.

Course Code	Course Name	Credits
MSEIE1017	**Disaster Management and Mitigation Measures**	**03**

Objectives:

1. To understand physics and various types of disaster occurring around the world.
2. To identify extent and damaging capacity of a disaster.
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster.
5. To understand application of GIS in the field of disaster management.
6. To understand the emergency government response structures before, during and after disaster.

Outcomes: On completion of the course, learner will be able to:

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs.
01	**Introduction:** Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	**06**
02	**Natural Disaster and Manmade disasters:** **Natural Disaster:** Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion **Manmade Disasters:** Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	**08**
03	**Disaster Management, Policy and Administration**: **Disaster management:** meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. **Policy and administration:** Importance and principles of disaster management policies, command and coordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	**06**
04	**Institutional Framework for Disaster Management in India:** Importance of public awareness, Preparation and execution of emergency management program. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations, Use of Internet and softwares for effective disaster management, Applications of GIS, Remote sensing and GPS in this regard.	**08**
05	**Financing Relief Measures:** Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams, International relief aid agencies and their role in extreme events.	**08**
06	**Preventive and Mitigation Measures:** Pre-disaster, during disaster and post-disaster measures in some events in general. Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication, Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	**06**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
2. All question carry equal marks.
3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. 'Disaster Management' by Harsh K. Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O. S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS – C. P. Lo Albert, K.W. Yonng – Prentice Hall (India) Publications.

(Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
MSEIE1018	**Energy Audit and Management**	**03**

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management.
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: On completion of the course, learner will be able to:

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities.
5. To analyze the data collected during performance evaluation and recommend energy saving measures.

Module	Detailed Contents	Hrs.
01	**Energy Scenario:** Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features, Basics of Energy and its various forms, Material and Energy balance.	**06**
02	**Energy Audit Principles:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR).	**08**
03	**Energy Management and Energy Conservation in Electrical System**: Electricity billing, Electrical load management and maximum demand Control, Power factor improvement, Energy efficient equipment and appliances, star ratings. **Energy efficiency measures in lighting system, lighting control:** Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	**06**
04	**Energy Management and Energy Conservation in Thermal Systems:** Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	**08**
05	**Energy Performance Assessment:** On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	**08**
06	**Energy conservation in Buildings:** Energy Conservation Building Codes (ECBC), Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources.	**06**

Assessment:

Internal:

Assessment consists of two tests out of which; one should be compulsory class test (on minimum Two Modules) and the other is either a class test or assignment on live problems or course project.

End Semester Theory Examination:

Some guidelines for setting up the question paper. Minimum 80% syllabus should be covered in question papers of end semester examination. In question paper weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of total six question.
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3. Questions will be mixed in nature (for example supposed Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3).
4. Only Four questions need to be solved.

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science.
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System.
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons.
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press.
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press.
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press.
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
MSEL101	**Computer Integrated Manufacturing Systems Lab**	**01**

Module	**Detailed Contents**	**Lab. Sessions**
01	Case study presentation /Actual Visits/Presentation on below topic- Operation, Control and Programming of various computer controlled machines in the FMS such as CNC machine tools, Automated Storage/Retrieval (AS/RS) systems, Robots, automated assembly station, etc.	**06**
02	Simulation and performance analysis of the FMS, parts flow control on Assembly station.	**03**
03	Study experiments on Integration aspects in computer integrated manufacturing environment.	**02**
04	Importance of Artificial Intelligence.	**01**
05	Machine vision based quality control	**01**

Assessment:
End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners

Course Code	Course Name	Credits
MSESBL101	**Advanced Manufacturing Lab**	**02**

Module	**Detailed Contents**	**Lab. Sessions**
01	Machining experiments to be conducted on the Vertical Machining Center that include Step turning, Taper turning, Threading and Grooving	**03**
02	Machining experiments to be conducted on the Vertical Machining Center that include Engraving, Mirroring, Rotation, Circular pocketing and Rectangular pocketing.	**03**
03	Design and manufacture of a composite job, highlighting an industrial application.	**02**
04	Manufacturing an industrial application component, using Selective Laser Sintering (SLS) technique.	**02**
05	Manufacturing an industrial application component, using Stereo lithography (SLA) technique.	**02**
06	Manufacturing an industrial application component, using Fused Deposition Modeling (FDM) technique.	**01**

Assessment:
End Semester Examination: Practical/Oral examination is to be conducted by pair of internal and external examiners